CLAIMS

1. A process for producing para-xylene from a feed containing xylenes, ethylbenzene and C9+ hydrocarbons, comprising at least the following steps:

- a step for adsorption in a unit (LM6) operating as a simulated moving bed from which at least three effluents are produced: an extract essentially constituted by para-xylene and desorbant; an intermediate fraction, termed the intermediate raffinate, which essentially contains ethylbenzene, and a second fraction, termed the 2-raffinate, which essentially contains a mixture of meta- and ortho-xylene;
- a step for isomerization of C8 aromatics, in a unit (IS19) operating in the vapour phase and converting ethylbenzene, to treat the intermediate raffinate;
- a step for isomerization of C8 aromatics in a unit (IS20) operating in the liquid phase or in the vapour phase, to treat the 2-raffinate.

2. A process according to claim 1, further comprising, between the adsorption step and the isomerization steps, a step for purifying the para-xylene of at least a portion of the extract by crystallization.

3. A process according to claim 1 or claim 2, comprising at least the following steps:

- sending the feed (1) to a distillation column (CD2) from which a mixture (3) is extracted overhead comprising the major portion of the meta-xylene, para-xylene, ethylbenzene and at least a portion of the ortho-xylene, and from which a stream (4) of C9-C10 hydrocarbons and the remaining portion of the ortho-xylene are extracted from the bottom;
- separating the overhead mixture (3) in a simulated moving bed in at least one separation column (LM6) containing a plurality of interconnected beds and operating as a closed loop, said column comprising at least five zones defined by the injections of the stream (3) constituting the feed for the column (LM6) and the desorbant (5) and the withdrawals of an extract (7) containing para-xylene, an intermediate raffinate (8) containing ethylbenzene and a 2-raffinate (9) containing ortho-xylene and meta-xylene, the para-xylene desorption zone 1 being included between the desorbant injection (5) and the extract removal (7); the ethylbenzene, ortho-xylene and meta-xylene desorption zone 2 being included between the extract removal zone (7) and the adsorption feed injection (3); the para-xylene adsorption zone 3A being included between the feed injection (3) and the intermediate raffinate withdrawal (8); the ethylbenzene adsorption zone 3B being included between the intermediate fraction withdrawal (8) and the 2-raffinate

withdrawal (9); and the zone 5 being included between the 2-raffinate withdrawal (9) and the desorbant injection (5);

- distilling the intermediate raffinate (8) in a column (CD11) to eliminate substantially all of the desorbant and withdrawing a first distilled fraction (14) containing ethylbenzene;
- distilling the 2-raffinate in a column (CD12) to eliminate substantially all of the desorbant and withdrawing a second distilled fraction (15);
- distilling the extract (7) in a column (CD10) to recover a fraction (13) which is enriched in para-xylene;
- sending said first distilled fraction (14) to a first zone for isomerizing C8 aromatics (IS19) operating in the vapour phase and converting ethylbenzene to obtain a first isomerate (22);
- sending at least a portion of said second distilled fraction (15) to a second xylene isomerization zone (IS20) to obtain a second isomerate (21);
- sending the first isomerate (22), after eliminating its light fractions, into a separation train (29) towards the distillation column (CD2);
- recycling the second isomerate (21) either (stream 40) to the simulated moving bed separation column (LM6) as a mixture with the overhead stream (3) from the distillation column (CD2) or (stream 41) to the distillation column (CD2) as a mixture with the feed (1).

4. A process according to claim 3, in which the fraction (13) from the extract (7) is enriched in para-xylene with a purity of at least 50%, and is sent to at least one crystallization zone (CR23) to deliver para-xylene crystals and a mother liquor, the crystals being separated from the mother liquor, optionally taken up in suspension, washed and recovered (stream 24) and the mother liquor (25) is mixed with the feed (1) supplying the simulated moving bed separation column (LM6) via the column (CD2).

5. A process according to one of the preceding claims, in which the first isomerization zone (IS19) operating in the gas phase is operated under the following conditions:

- a temperature of more than 300°C;
- a pressure of less than 4 MPa;
- an hourly space velocity (HSV) of less than 10 h^{-1};
- a catalyst containing a zeolite with structure type EUO and at least one group VIII metal;
- a H_2/hydrocarbon molar ratio of less than 10.

6. A process according to one of the preceding claims, in which the second isomerization zone (IS20) operating in the liquid phase is operated under the following conditions:
   - a temperature of less than 300°C;
   - a pressure of less than 4 MPa;
   - an hourly space velocity (HSV) of less than 10 h^{-1};
   - a catalyst containing a ZSM-5 type zeolite.

7. A process according to one of claims 3 to 6, in which the stream (4) from the bottom of the distillation column (CD2) is distilled in a distillation column (CD32) to produce an overhead stream (33) of high purity ortho-xylene, and a bottom stream (34) containing C9-C10 hydrocarbons.

8. A process according to claim 7, in which the stream containing ortho-xylene (33) is recycled to the isomerization zone in the liquid phase (IS20).

9. A process according to one of the preceding claims, in which the adsorbent used in the simulated moving bed separation unit (LM6) is a barium-enriched X zeolite or a potassium-enriched Y zeolite or a barium- and potassium-enriched Y zeolite.

10. A process according to one of the preceding claims, in which the desorbant used in the simulated moving bed separation unit (LM6) is selected from para-diethylbenzene, toluene, para-difluorobenzene or a mixture of diethylbenzenes.

11. A process according to one of the preceding claims, in which the volume ratio of the desorbant to the feed in the simulated moving bed separation unit (LM6) is in the range 0.5 to 2.5.

12. A process according to one of the preceding claims, in which the simulated moving bed separation unit (LM6) is operated at a temperature in the range 20°C to 250°C and at a pressure in the range from the bubble point of xylenes at the operating temperature to 2 MPa.

13. A process according to one of claims 3 to 12, in which the ethylbenzene content of the second distilled fraction from the 2-raffinate (stream 15) is at most 5% by weight.

14. A process according to one of the preceding claims, in which the gas phase isomerization unit (IS19) comprises a zeolite with structure type EUO and at least one metal from group VIII of the periodic table in a proportion of 0.01% to 2% by weight with respect to the catalyst.

15. A process according to one of the preceding claims, in which the catalyst from the gas phase isomerization unit (IS19) contains an EU-1 zeolite and platinum.

16. A process according to one of claims 3 to 15, in which a portion of the distilled stream from the 2-raffinate (stream 15) is sent to a set of units which can produce high purity meta-xylene and/or ortho-xylene.

17. Use of a process according to one of the preceding claims, in the context of a modification to an existing unit with a view to increasing the quantity of para-xylene produced.